

## VOC Surveillance using EPA's Trace Atmospheric Gas Analyzer (TAGA) and ASPECT Aerial Platform FTIR

In a heavily industrialized area in Southeast Texas, EPA atmospheric scientists recently conducted an inter-comparison study of the EPA mobile Trace Atmospheric Gas Analyzer (TAGA) and the ASPECT Aerial Platform FTIR. The TAGA is a mobile air sampling device that is capable of detecting a wide-range of volatile organic compounds in ambient air in the Part Per Trillion range. The ASPECT aerial platform FTIR is an aircraft mounted Fourier Transform Infrared detector that includes a 16 band line scanner, thermal imaging camera and digital camera. The ASPECT generally detects most VOCs in the low part per million range although significantly lower detection levels are possible for select chemical species. For this study, fenceline monitoring with the TAGA was conducted while aerial platform ASPECT recordings were conducted. Results of this investigation are presented below.



The purpose of the project is to determine the concentration and distribution of the pollutants of concern in the Jefferson County (urban) area. The Jefferson County area, as designated by the U.S.EPA, consists of the Assessment Areas of Port Neches, Beaumont, and Port Arthur. To the north and east of these urban areas is the Neches River and beyond that is primarily inaccessible wet land. The monitoring of Urban Air Toxics, therefore, concentrated on the urban/industrial areas of Port Neches, Beaumont, and Port Arthur.

There are currently 188 hazardous air pollutants (HAPs), or air toxics, regulated under the Clean Air Act as a result of the Clean Air Act Amendments of 1990. These pollutants have been associated with a wide variety of adverse health effects.

The U.S.EPA has identified 33 of the 188 HAPs, as posing the greatest threat to public health in urban areas. These HAPs include 18 volatile organic compounds (VOCs), 9 metals/metal compounds, and 6 other HAPs. To respond to this public health threat, the U.S.EPA has established a national effort to reduce air toxics from mobile and stationary sources. On July 19, 1999, the U.S.EPA published its Urban Air Toxics Strategy (Strategy) in the *Federal Register*.

A critical element of this Strategy is to move to a more risk-based program for reducing HAPs, particularly in urban areas. Urban areas are an important focus for research needs, since these areas are typically heavily industrialized, densely populated, and tend to be economically disadvantaged. Additionally, multiple sources of a combination of HAPs create a combined toxic effect that is not usually accounted for in typical assessments.

In support of the Strategy and to obtain sufficient ambient air monitoring data, the U.S.EPA, Office of Air Quality Planning and Standards developed a draft Air Toxics Monitoring Concept Paper. This Concept Paper recognizes the need for a national ambient air toxics monitoring network, stresses the need to build upon existing monitoring programs, and cites the need to take advantage of mobile and stationary monitoring resources.

The U.S. EPA has designated a number of assessment areas to be monitored for Urban Air Toxics. U.S. EPA Region VI has included southeastern Texas, Jefferson County, which is a heavily industrialized corridor, and, based upon data reported to the 1996 National-scale Air Toxics Assessment program, had the worst ambient air quality of all counties in the five state region.

According to a report published by a coalition of the National Environmental Trust, Physicians for Social Responsibility and Learning Disabilities Association of America; Louisiana and Texas lead the nation in air emissions of developmental and neurological toxins, with the most common sources being manufacturing, petroleum refining, and



## Pollutants of Concern

A review of the HAP emissions inventory for the Jefferson County area and the 33 Urban Air Toxics, revealed the following pollutants to be of concern:

|                           |                    |                     |
|---------------------------|--------------------|---------------------|
| Benzene                   | 1,3-Butadiene      | Chloroform          |
| Carbon Tetrachloride      | 1,2-Dibromoethane  | 1,2-Dichloropropane |
| 1,3-Dichloropropene       | 1,2-Dichloroethane | Methylene Chloride  |
| 1,1,2,2-Tetrachloroethane | Tetrachloroethene  | Trichloroethene     |
| Vinyl Chloride            |                    |                     |

## Data Quality Objectives

Monitoring for air toxics was performed in the field primarily with the U.S.EPA/ERTC's ECA TAGA IIe instrument although this project also included a photoionization detector, offsite TO-15 analysis, and the ASPECT FTIR. TAGA monitoring consisted of both mobile and stationary TAGA Mobile Laboratory analysis. The TAGA performed real-time monitoring throughout the Port Neches, Beaumont, and Port Arthur Assessment Areas for the pollutants of concern using a selected positive ion technique.

The TAGA instrument identifies pollutants based upon specific parent and daughter ions. The parent and daughter ions that have been determined appropriate for the thirteen pollutants of concern. Due to the need to identify the pollutants, irrespective of potential interferences, more than one set of parent/daughter ions were selected and applied to this effort. The TAGA instrument and associated software accumulated the ion counts per seconds for each parent/daughter ion pair selected. This raw data was retained by the on-board data collection system. In addition, handwritten operators' notes citing location and/or events were recorded.

To identify the geographic location of the TAGA Mobile Laboratory while ambient air quality monitoring data was being gathered, an on-board Global Positioning Satellite (GPS) system was employed. Positions conveyed by this system are expected to be accurate to within 2 meters, with real-time or post processing correction.

To assist in the TAGA ambient air monitoring effort, additional ambient air monitoring was performed using a photo-ionization detector (PID) MultiRAE with data logging capabilities. This PID obtained ambient air from the same sampling port as the TAGA IIe instrument. When the PID indicates ambient concentrations above 1 ppmv (part per million by volume), a sample of ambient air was collected in a Summa canister using grab sampling techniques. Similarly, when the TAGA detected ambient concentrations above 50 ppbv (parts per billion by volume), a sample of ambient air was collected in a Summa canister. All such samples were collected from the same sampling port as the TAGA instrument. The U.S.EPA Region VI Houston Laboratory analyzed samples collected in the Summa canisters for VOCs by U.S.EPA Method TO-15.

Meteorological data was downloaded from several met stations maintained by the Texas Commission on Environmental Quality (TCEQ). The TCEQ has a state-wide network of meteorological stations with data available real time in 5-minute averages. TCEQ met data was obtained from the following four meteorological stations:

| Name             | Location                           | Data Available  |
|------------------|------------------------------------|---|
| Port Neches      | 29 Deg 59' 27" N, 93 Deg 57' 12" W | Wind Speed (WS), Wind Direction (WD), Temp, Deviation of WD (DWD) |
| Carol State Park | 30 Deg 4' 1" N, 94 Deg 4' 38" W    | WS, WD, DWD, Temp,  |
| Beaumont         | 30 Deg 2' 22" N, 94 Deg 4' 29" W   | WS, WD, DWD, Temp, Solar Radiation                                |
| Port Arthur      | 29 Deg 53' 39" N, 93 Deg 59' 15" W | WS, WD, DWD, Temp, Solar Radiation                                |

## ASPECT Aerial Platform FTIR



The ASPECT aerial platform FTIR is a mobile FTIR system housed in an Aerocommander airplane. The instrumentation generally detects various volatile organic chemicals (VOCs) in the low part per million range although significantly lower detection levels are possible for select chemical species. The ASPECT aerial platform FTIR is an aircraft mounted Fourier Transform Infrared detector that includes a 16 band line scanner, thermal imaging camera and digital camera.

## DATA RESULTS

### ASPECT Data Results

The ASPECT collected evening and night time line scanner and digital imagery on two successive nights in southeast Texas. Only one image detected absorption of infrared light in any of the wavelengths investigated for this study. [Appendix A](#) shows a potentially leaking seal on an above ground storage tank that likely contains benzene. Detection limits for the ASPECT were likely in the 1 to 100 part per million (volume) range although additional dispersion modeling or ground level fugitive leak sampling would help provide a more accurate approximation of ground level VOC concentrations. One characteristic of airborne platform remote sensing is that all contaminants that absorb a portion of the light are collapsed into a horizontal plane when projected onto a 2- dimensional plane such as an aerial photograph. Three dimensional concentration data could only be detected using this method if additional dispersion modeling was performed or improvement in light detection and ranging (LIDAR) methodologies facilitate 3 dimensional depth and concentration data. This method of remote sensing is of significant value in large oil or chemical spills or releases of substances that are at significantly different temperatures or absorptions of infrared light. The current state of the science does not appear to be adequate to detect a range of potentially toxic or carcinogenic substances in ambient air although for some select substances the methodology may bear investigation as a substantial investigative tool.



### Trace Atmospheric Gas Analyzer Results

Trace Atmospheric Gas Analyzer (TAGA) sampling was collected on four consecutive evenings from generally 8:00 pm until approximately 4:00 am the following morning. Results of these efforts are presented in [Appendix B](#). Results indicate that VOC concentrations in the area were relatively low during the study period although several areas indicate future focus is warranted. Short term releases of benzene and several other chemicals of concern were detected above quantification levels although concentrations appeared to dissipate within the study area and were substantially below Occupational Safety and Health Administration(OSHA) Permissible Exposure Levels (PELs) for worker protection. Several chemicals exhibited short term concentrations above the Texas Health Effect Screening Levels although daily monthly and annual concentrations would likely be consistent with these values. Please note that on several occasions instrument error occurred just as the run was being terminated that resulted in a single spike in apparent concentration for various chemicals of concern. This anomaly has been attributed to an apparent voltage spike as the instrument is being shut down. ERT scientists will investigate this technical difficulty to attempt to eliminate this instrument error in future field work.

## CONCLUSIONS

Sampling results indicate that VOC concentrations in the area were relatively low during the study period. Both instruments were field rugged and portable and required significant operator technical ability to

accomplish the mission.

Aerial platform spectroscopy appears to be of significant value in large oil or chemical spills or releases of substances that are at significantly different temperatures or absorptions of infrared light. The current state of the science does not appear to be adequate to detect a range of potentially toxic or carcinogenic substances in ambient air although for some select substances the methodology may bear investigation as a substantial investigative tool.

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## REFERENCES

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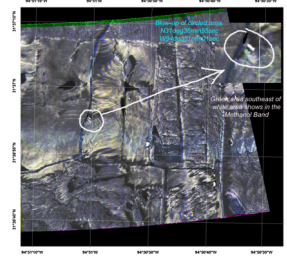
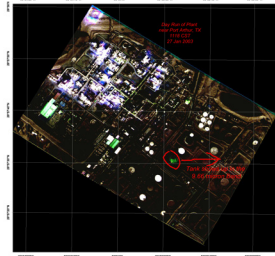
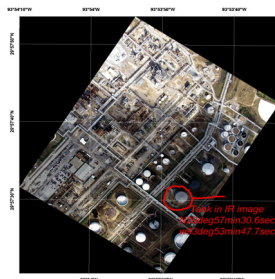
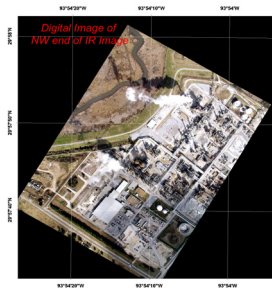
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## APPENDIX A

Photos show a potentially leaking seal on an above ground storage tank that likely contains benzene.



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